

Name:

## Crater Lake Science & Learning Center

National Park Service  
U.S. Department of the Interior

Crater Lake National Park



# Crater Lake National Park

## Spring Study Guide

**The oldest stories of Crater Lake speak of an epic battle between Earth and Sky. While the volcano now sleeps, the battle continues.**

For 7,700 years, the sky has bombarded Crater Lake with freezing wind and snow. Some of this snow falls into the lake, recharging it with pure water. The rest covers the caldera's slopes with an icy blanket. To survive this frozen attack, some creatures migrate, some hibernate, and some put up a fight. The only species that are tough enough to live on the slopes of Mt. Mazama rely on special adaptations to survive the wrath of the sky.



***Mountain hemlock trees survive the winter at Crater Lake.***

Extreme snowfall is a trademark of Crater Lake. Deep snow lasts most of the year, which is an advantage to plants that tolerate short summers. Deep snow also insulates the habitats of small animals, like pika, who need stable air temperatures to survive. Every organism at Crater Lake faces extreme conditions, and interestingly, they couldn't survive without them.

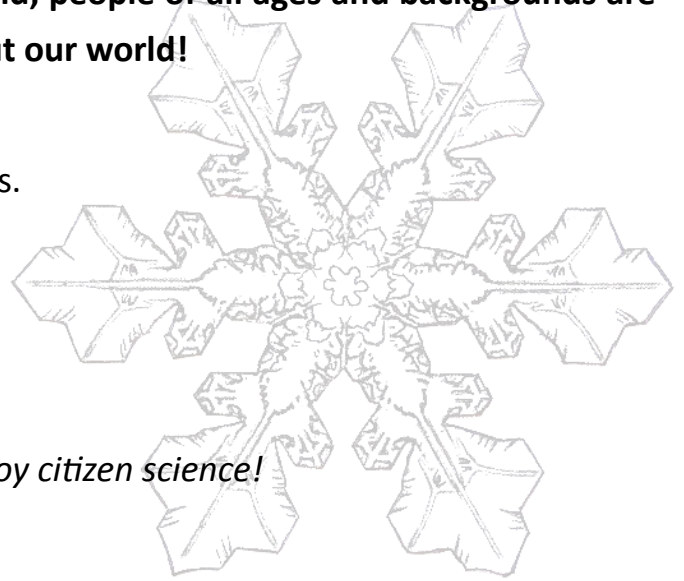
Alarmingly, snowfall has decreased at Crater Lake. Scientists observe that warmer air temperatures throughout the winter are producing more rain and less snow than before. This surely will affect all of the species living on the volcano. We need your help as citizen scientists to study the effects of climate change at Crater Lake. Complete this study guide so you are ready to make new scientific discoveries and protect your park!

# Who is a Citizen Scientist?

A citizen scientist can be anyone! All over the world, people of all ages and backgrounds are helping professional scientists discover more about our world!

Check the following boxes if they apply to you.

- ☐ I want to understand how the world works.
- ☐ I like to spend time outside.
- ☐ I like to help others.
- ☐ I like making new discoveries.



*\*If you checked even one box, you will probably enjoy citizen science!*

## We need your help!

If you're up for the challenge, we need you to volunteer to be a citizen scientist during your field trip to Crater Lake. Here's what we need you to do:

1. At school before the trip, complete this study guide to learn about the famous snowpack and forests of Crater Lake. You will develop a hypothesis that you can test at the park.
2. At Crater Lake, measure and record *snow depth* and *needle growth* on mountain hemlock trees.
3. Back at school, analyze your measurements with an online map to support or reject your hypothesis. Your analysis will help park scientists manage the park's forests.



***Draw yourself as a citizen scientist at Crater Lake!***

**Include:**

- ◇ snowshoes
- ◇ warm clothes
- ◇ snow depth probe
- ◇ magnifying glass

# Snowfall at Crater Lake National Park

## How has snowfall changed at Crater Lake National Park?

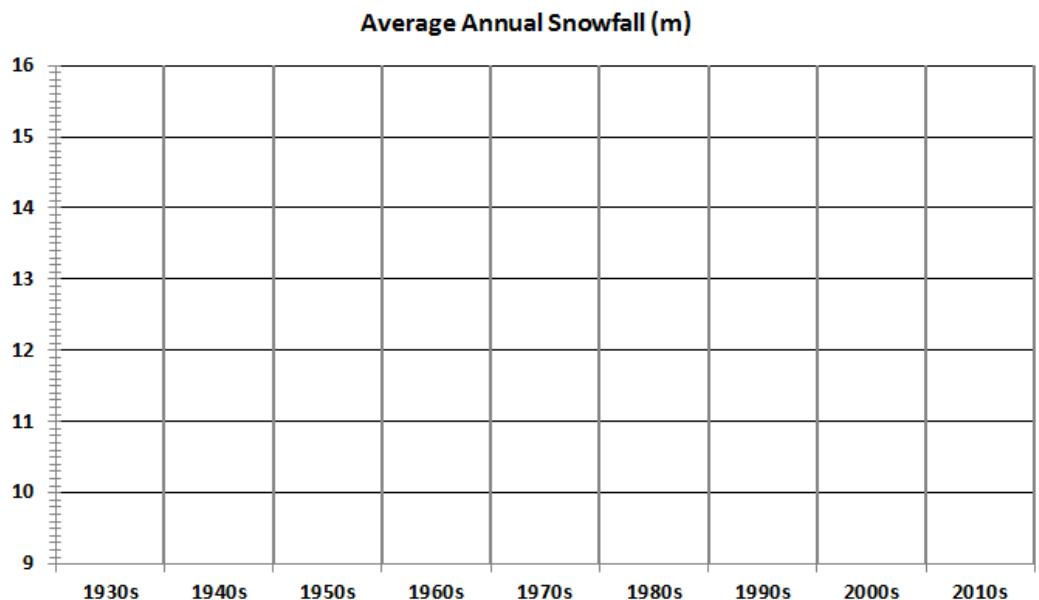
It snows at Crater Lake National Park most of the year. Species living year round at Crater Lake are well adapted to heavy snowfall and depend on a deep snowpack to survive. The National Park Service has measured snowfall at Crater Lake since 1931. Below, the table displays average annual snowfall (in meters) for each decade.



*A ski jumper glides above Park Headquarters in the winter of 1932.*

***Draw and color a bar graph representing the snowfall data in the table.***

Average Annual Snowfall	
1930s	15.6 m
1940s	15.8 m
1950s	14.5 m
1960s	12.9 m
1970s	12.6 m
1980s	12.1 m
1990s	12.5 m
2000s	11.6 m
2010s	9.6 m



***According to the data, how has snowfall changed at Crater Lake National Park?***

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# ***Imagine taking an 8-month vacation...***

...to Crater Lake. You know you'll go through a lot of changes on this trip, but change is what you're used to. You arrive before the crowds on the first cold day of autumn. You have no trouble settling in to your surroundings. You spend your days and nights in the forest, greeting all who pass with your sparkling smile. As winter approaches, many friends and relatives come to stay with you. They put pressure on you to change to be more like them, but you are unique and this is your journey.

As you relax in your cozy surroundings, you start to become worried about the younger visitors arriving at the lake. They sweep into the forest, bounce around, take up space, and worst—they don't even look where they're going. But, you know these "brilliant" new visitors have to deal with the icy grip of winter—rock cliffs, blizzards, intense sunshine, and howling wind. They don't have the protection of others to insulate them from the harsh winter environment.

As you worry about the others, you don't realize the air temperature surrounding you is just above freezing. You begin to feel hot. **Oh no!** Little pieces of you start to come apart and dissolve into the air. You're dripping with sweat as the last bits of you seep into the soil. In the dark spaces between the roots, you wonder where you'll travel next...

***Read the story and try to solve the riddle.***

***What are you in this story?***

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***Write a paragraph describing where you would like to go next on your journey...***

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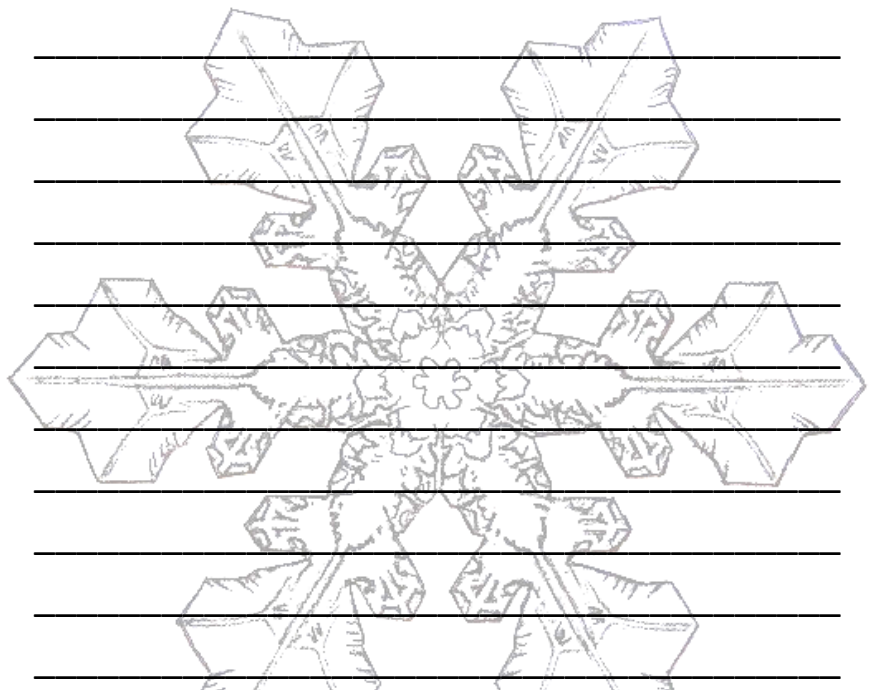
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# The Mountain Hemlock Forest



*A mountain hemlock.*

**If it droops on top,  
it's a mountain hemlock.**

The mountain hemlock (*Tsuga mertensiana*) is a tree best known for its beauty and its ability to live in extremely snowy environments. It is important to humans because the mountain hemlock forests soak up sun, providing shade and keeping mountain snow from melting too early in the spring. This allows our rivers to flow cold and fresh all summer long. Of course, they're also important to many animals to whom they provide food and shelter.

***Identify and label at least five  
mountain hemlocks in the photo.***





# Animals of the Mountain Hemlock Forest

When winter arrives, animals living in the mountain hemlock forests of Crater Lake use different strategies to survive. Some change their behavior, some change their color, and some change their habitat.

**Solve the scrambled words, then draw a line to match each animal with its winter adaptation.**



Vole

In the winter, the snow at Crater Lake can be over 10 feet deep—too deep for me to graze on grass. That's why, before winter comes, I leave the park. Scientists call this behavior...

**M**  
R I T G A I N O



Elk

Winters here are cold! My brown fur looks warm, but to keep from freezing I dig tunnels deep into the snow and huddle together with members of my family. The snow above us acts like a warm...

**B**  
E N T K A L



Snowshoe Hare

In the summer, I eat flowers and grasses. In the winter, I'm forced to eat tree bark and evergreen needles. Fortunately, my big hind feet allow me to hop on top of the snow without...

**S**  
G N I K I N



Gray Jay

In the summer, I run around eating seeds. To survive the winter, I burrow into the ground. I lower my temperature and heart rate to save energy. It looks like I'm asleep! Scientists call this...

**H**  
E T N I B I N R O A



Long-Tailed Weasel

In the summer, my fur is brown. In the winter, I grow a white coat—the color of the snow! It keeps me hidden from my prey, as well as from predators such as bobcats and owls. My fur is an example of...

**C**  
U G A F L A M E O



Ground Squirrel

All summer long, I gather seeds and insects. I glue them (using my sticky saliva) to tree trunks around the park. In the winter, I fly from tree to tree and eat my stored snacks. So, I survive the winter by...

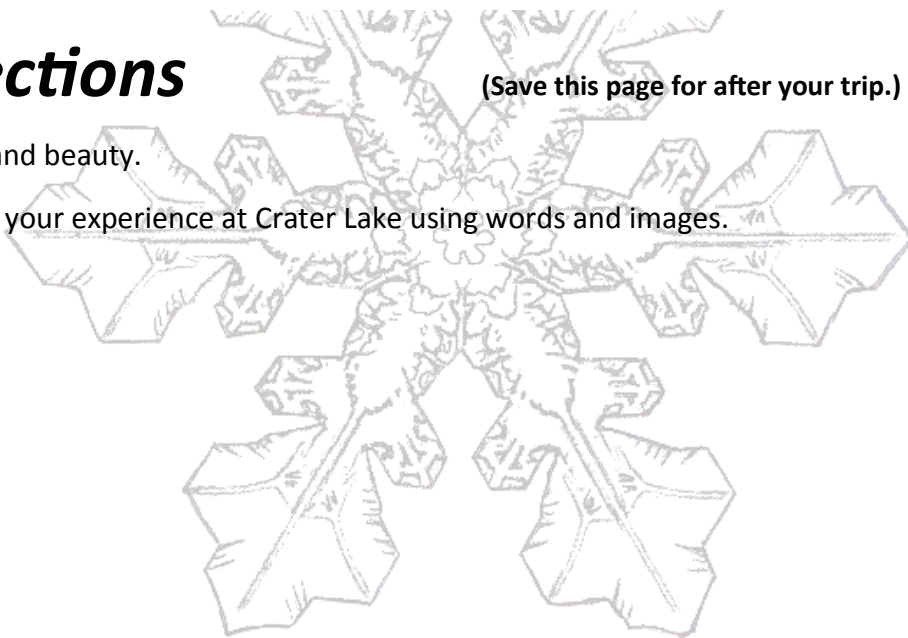
**P**      **A**  
A I L G N N N      E H A D

# ***Crater Lake Reflections***

(Save this page for after your trip.)

Crater Lake is best known for its peace and beauty.

After your visit, use this page to express your experience at Crater Lake using words and images.



# Climate Change at Crater Lake National Park

## How does a warming climate change the ecosystems at Crater Lake National Park?

Park scientists aren't exactly sure how warming air temperatures will affect the ecosystems at Crater Lake. One concern is that warmer air temperatures will allow trees from lower elevations to grow higher up the mountainside. These newcomers could outcompete the species on the mountaintop.

There is only one species of tree at Crater Lake that lives above the mountain hemlock forest. It's the endangered whitebark pine (*Pinus albicaulis*). If warmer temperatures allow mountain hemlocks to grow at the same elevations as whitebark pines, they might use up most of the resources in the soil and air, leaving the whitebark pines to die.

Scientists know that there are steps we can take at home to slow the warming of the climate. When you visit the park on your field trip, rangers will ask you to study how climate change currently affects the park's ecosystems. You will measure the timing of needle growth on mountain hemlocks and compare it to snow depth measurements that you'll make around the trees. These measurements will be used by park scientists to understand how forest species will change at Crater Lake as winters continue to get warmer.

You're going to use impressive scientific tools when working as a citizen scientist at the park, but they're only useful if you know what you're looking for. As a scientist, it's important to develop a hypothesis before going out into the field. A hypothesis is what you think you're going to find out.

## MAKE YOUR HYPOTHESIS!

*Botanists think that warm, spring temperatures signal to mountain hemlocks that it's time to begin growing needles. On your field trip, you are going to measure snow depth and compare it to mountain hemlock needle growth.*

***But first, make a hypothesis...***

**I will observe mountain hemlocks growing young needles sooner when...**

☐ They are surrounded by deeper snow.

☐ They are surrounded by less deep snow.

**Explain your hypothesis:**

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